NON-PUBLIC?: N
ACCESSION #: 9411040294
LICENSEE EVENT REPORT (LER)

FACILITY NAME: HOPE CREEK GENERATING STATION PAGE: 1 OF 5

DOCKET NUMBER: 05000354

TITLE: Reactor Protection System Actuation - Invalid Main Turbine trip results in reactor scram due to design deficiency
EVENT DATE: 10/02/94 LER #: 94-014-00 REPORT DATE: 10/31/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Lou Aversa, Senior Staff Engineer - TELEPHONE: (609) 339-3386
Technical

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS: no

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On Sunday evening, October 2, at 2036, with the unit operating at 100% of rated power, a reactor scram occurred due to a sudden trip of the main turbine generator. The main turbine trip and trip of the "B" reactor feed pump were not preceded by any alarms or indications of a problem with either component. Control room personnel took appropriate actions to verify the scram and that all automatic actions were complete. A review of the alarm chronolog did not indicate the source of the turbine trip. A review of the turbine first hit panel (local EHC cabinet) indicated the customer trip (Reactor Level 8 @ +54"), caused the main turbine trip. The main turbine control valve closure input to RPS provided the scram signal. The turbine trip resulted in a high reactor pressure above the LO-LO SRV setpoint for H and P valves and opening of "K" on its safety valve function. In addition a dual recirc pump trip and alternate rod insertion signals were provided when

pressure increased above the ARI and RRCS initiation setpoints. The reactor water cleanup isolation valve 1BG-HV-F001 also closed due to level instrument ringing. The cause of the main turbine trip and subsequent scram, was due to a design deficiency in the Digital Feedwater Control System (DFCS). The design was to require two redundant high level signals to cause a main turbine trip. The system was actually configured such that either of two signals would trip the turbine. Corrective actions included a design change to correct the deficiency, as well as, testing of the bailey logic card which is suspected of failing and initiating this event. The Engineering department has also completed a review of the DFCS and is confident that critical portions of the system have been designed, installed, modified and tested appropriately to assure proper operation.

END OF ABSTRACT

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor (BWR/4)
Digital Feedwater Control System EIIS IDENTIFIER (JB)
Main Turbine Generator (CA) EIIS IDENTIFIER (TA)
Reactor Feedwater System (EA) EIIS IDENTIFIER (SJ)

IDENTIFICATION OF OCCURRENCE

TITLE (4): Reactor Protection System Actuation - Invalid Main Turbine Trip results in Reactor Scram due to design deficiency.

Event Dates: 10/2/94
Event Time: 2036
This LER was initiated by Incident Report No. 94-163

CONDITIONS PRIOR TO OCCURRENCE

Plant in OPERATIONAL CONDITION 1 (Power Operation)
Reactor Power 100% of rated, 1097 MWe

DESCRIPTION OF OCCURRENCE

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actions to verify the scram and that all automatic actions were complete. A review of the alarm chronolog did not indicate the source of the turbine trip. A review of the turbine first hit panel (local EHC cabinet) indicated the customer trip (Reactor Level 8 @ +54"), caused the main turbine trip. The main turbine control valve closure input to RPS provided the scram signal. The turbine trip resulted in a high reactor pressure above the LO-LO SRV setpoint for H and P valves and opening of K on its safety valve function. In addition a dual recirc pump trip and alternate rod insertion signals were provided when pressure increased above the ARI and RRCS initiation setpoints. All turbine bypass valves opened in response to the pressure increase that resulted from the turbine trip. The reactor water cleanup isolation valve 1BG-HV-F001 also closed due to level instrument ringing.

A short time into the event "A" and "C" reactor feed pumps tripped (16 and 12 seconds respectively). The 1 and 2 feedwater heater strings isolated following the turbine trip. The 1 and 2 feedwater heaters were bypassed, "A" and "C" reactor feed pumps were reset, and reactor level was restored within normal operating band (12.5" to 54"). Reactor water cleanup system was restored and reactor recirculation pumps were started, to minimize thermal stratification. A HPCI high level trip occurred, due to level instrument ringing, and was reset. Actual reactor level during the transient remained between 45" to -20".

ANALYSIS OF OCCURRENCE

The Digital Feedwater Control System (DFCS), installed during the last Refuel Outage, is designed to control feedflow to the reactor under all operating conditions. In addition, the DFCS provides the level 8 trip signals for the main and reactor feedpump turbine trip protection at Hope Creek. This is accomplished via redundant 2 out of 3 logics. The main turbine level 8 trip was intended to require two level 8 logics, primary and confirmatory, to trip the main turbine. The output of the new digital system is routed to the Bailey solid state logic control system that provides the trip signals to individual components.

A review of the alarm chronolog indicated that the main turbine trip was the initiating signal for the scram. The main turbine trip first hit panel indicated that the level 8 trip caused the turbine trip. A review of the reactor level traces did not indicate any level perturbations prior to the trip. The B reactor feedpump trip also resulted from an invalid level 8 at approximately the same time of the turbine trip. An engineering review of the digital feedwater control system was initiated to determine the cause of the level 8 signal. As no level 8 alarms were

received the initial investigation could not determine the cause of the turbine trip. The review team found a Bailey logic card for the B reactor feedpump was also utilized to provide the confirmatory signal for the main turbine trip. Since both of the components utilize this common card, the team decided to review the trip logic scheme. The review determined the relays, that were to provide the redundant trip signals, were connected in parallel rather than in series. This condition allowed a single level 8 signal, whether valid or invalid, to trip the main turbine.

The installed scheme had not been completely reviewed against the design intent to verify proper installation. In addition, this feature was not adequately tested following DCP installation to verify that both signals would be required to trip the main turbine.

The proposed failure of the Bailey card input could not be confirmed through followup testing. This type of intermittent failure has been identified previously with similar difficulties in recreating the failure. The failure of this card, or the input signal to the card, should have resulted in a trip of the B feedpump only if the original design concept was incorporated into the plant. The failure of the card therefore, is believed to be the initiating event but the root cause of the scram has been directly attributed to the design deficiency.

ANALYSIS OF OCCURRENCE (Con't)

Reactor level ringing was observed due to a -38 inches (L2) channel "All flashing light on primary containment isolation (PCIS) indicator with no other equipment actuations or instrument indications of level 2. The Nuclear Steam Supply System level was reset clearing the "A" channel PCIS flashing light. High pressure coolant injection (HPCI) received an invalid 54" (L8) trip signal. These actuations are associated with the channel "A" reactor level instruments.

Additional equipment actuations as a result of the turbine trip included a dual recirc pump trip and an alternate rod insertion signal from the redundant reactivity control system as reactor pressure reached the 1071 PSIG actuation setpoint. Two safety relief valves actuated on Lo-Lo set function when they armed at 1047 PSIG.

Safety relief valve "K" (lift setpoint 1108 PSIG) actuated following the turbine trip. A review of the available reactor pressure traces indicated reactor pressure peaked at approximately 1080 PSIG. As the accuracy of available pressure data could not confirm the lift setpoint

to be within its allowable limits "K" SRV was declared inoperable. A review of the alarm chronolog, DFCS alarm history and GETARS traces did not indicate any process variable being exceeded that would cause the "A" and "C" feedpump trips. Feedpump trip circuits were tested following the event with no abnormal conditions noted or a definitive reason for the trips. The RWCU isolation resulted from the instrument ringing. The actuation was invalid as the -38", reactor level 2 (L2) setpoint was not actually reached. The reactor water sample valve isolation, which also actuates on the (L2) signal did not occur. This was due to a relay race created by the level instrument ringing that was observed following the turbine trip. A review of previous surveillance tests confirmed the valve does isolate upon receipt of a valid signal. Additional testing is scheduled to confirm the valve isolates upon receipt of a valid signal.

SAFETY SIGNIFICANCE

This incident posed minimal safety significance. Plant systems required to mitigate the consequences of this type of event operated per design.

PREVIOUS OCCURRENCES

There has been one previous reactor scram attributed to deficiencies associated with the Digital Feedwater Control System. (LER 94-007-00)

APPARENT CAUSE OF OCCURRENCE

The root cause of this event was a design deficiency associated with the Digital Feedwater Control System. The initial design concept to have a redundant set of signals trip the main turbine was not incorporated correctly which allowed a single failure to trip the turbine. A contributing factor was that post design change testing did not verify that the design feature was installed correctly.

CORRECTIVE ACTIONS

The confirmatory level 8 trip for the main turbine has been wired correctly.

The suspect bailey card has been replaced.

A multidiscipline team reviewed the Digital Feedwater System, prior to startup, and is confident that the critical portions of the system have been designed, installed, modified and tested appropriately to assure

proper operation.

The K SRV which is suspected of lifting prematurely has been declared inoperable.

The suspect Bailey card is undergoing testing to corroborate the findings of the investigation team.

The reactor pressure transmitter circuits that provide input to the General Electric Transient Analysis Response System (GETARS) will be modified to provide improved accuracy to enhance diagnostic capabilities.

An additional assessment team is performing a review to ensure that the original design concept of the DFCS was carried through to final installation and testing.

Additional time delay will be added to selected instruments to reduce invalid equipment actuations resulting from instrument ringing.

Sincerely,

R. J. Hovey
General Manager -
Hope Creek Operations

SORC Mtg. 94-075 Recommended approval: Yes
C Distribution

ATTACHMENT TO 9411040294 PAGE 1 OF 1

PSE&G

Public Service Electric and Gas Company P.O. Box 236 Hancocks Bridge, New Jersey 08038

Hope Creek Generating Station

October 31, 1994

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

HOPE CREEK GENERATING STATION
DOCKET NO. 50-354
UNIT NO. 1
LICENSEE EVENT REPORT 94-014-00

This Licensee Event Report is being submitted pursuant to the requirements of 10CFR 50.73(a)(2)(iv).

Sincerely,

R. J. Hovey
General Manager -
Hope Creek Operations

LAA/

Attachment
SORC Mtg. 94-075
C Distribution

The Energy People 95-2173 (25M) 12-89

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